30 th IECEC

Topical area: Aerospace Power Systems
Space Power Systems

Authors: Artur B. Chmielewski, Richard Ewell, Richard Bennett, Bill Nesmith

Affiliation: Jet Propulsion Laboratory
Pasadena, Ca.
Phone: 818-354-0255, fax **818-393-7242**

Title: The Powerstick Development

Abstract

In the pursuit of faster, better, cheaper, Jet Propulsion Laboratory (JPL) is scaling down all of its missions. Small spacecraft take advantage of technological progress in miniaturization, microchips, microgears and lightweight structures. Just about every spacecraft subsystem has gone through a shrinking process.

The only heavy spacecraft component that resisted change is the power source. The lack of small power sources was especially evident when feasibility of a Mars mini station and micro rover network was studied. Small Mars landers will have very limited missions unless a device like the powerstick is developed. Such landers shy away from Radioisotope Thermoelectric Generators (RTGs) because of the unavailability of small units and the high costs to develop them. The concept of the powerstick was presented a year ago. Since then the powerstick went from being just an idea to a laboratory proof-of-concept test article.

The powerstick satisfies power source demands for small missions at a potentially very small price. The powerstick is a miniature power source that consists of a Radioisotope Heater Unit (RHU), a thermoelectric thermopile and a bank of "AA" batteries. The RHU is a spot heater produced by Deli and commonly used on spacecraft. The RHU is used in the powerstick as a source providing heat to a thermoelectric element. It appears that the powerstick, using a single RHU and a bismuth -telluride thermoelectric converter, is capable of producing 42 miliwatts and 15 V at the beginning of life. This would reduce to 37 miliwatts at 14 volts after 10 years of operation. This electricity would trickle charge the lithium batteries

providing peak power to a micro rover, a mini meteorological station or a micro spacecraft.

The paper will describe the results of the proof-of-concept testing of the powerstick hardware and how the findings affected the prototype design. The thermal modeling will be explained and its impact on the selection of insulation and case materials. The attractive feature of the powerstick is its potential low development cost. Estimates of the development and recurring cost of flight qualified hardware were obtained. The paper will conclude with a discussion of these estimates.